DOCUMENT RESUME

ED 152 558 SE 024 091

AUTHOR Deal, Gerald A.; Montgomery, James A.
TITLE A Guide for Developing Standard Operating Job Procedures for the Screening & Grinding Process Wastewater Treatment Facility. SOJP No. 1.
INSTITUTION Charles County Community Coll., La Plata, Md.
SPONS AGENCY Environmental Protection Agency, Washington, D.C. Div. of Manpower Training.
PUB DATE [75]
GRANT EPA-900253
NOTE 64p.; For related documents, see SE 024 092-097; Contains occasional light and broken type

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Guides; Industrial Training; *Job Training; Safety; Technical Occupations; Technical Reports; *Utilities; *Waste Disposal; Water Pollution Control; *Water Resources

ABSTRACT

This guide describes standard operating job procedures for the screening and grinding process of wastewater treatment facilities. The objective of this process is the removal of coarse materials from the raw waste stream for the protection of subsequent equipment and processes. The guide gives step-by-step instructions for safety inspection, start-up procedures, continuous operating procedures, and shut-down procedures. (Author/BB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED152558

S.O.J.P.

1

SOJP NO 1

SCREENING AND GRINDING

A GUIDE FOR THE DEVELOPMENT OF

STANDARD OPERATING JOB PROCEDURES

FOR WASTE WATER TREATMENT PLANT UNIT OPERATIONS

DEVELOPED BY
CHARLES COUNTY COMMUNITY COLLEGE
LA PLATA, MARYLAND

GRANT NO 900253
MANPOWER DEVELOPMENT STAFF,
ENVIRONMENTAL PROTECTION AGENCY.

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Bernard J. Lukco

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

CERIC

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

SE 024 091

A GUIDE FOR DEVELOPING

STANDARD OPERATING JOB PROCEDURES

FOR THE

SCREENING & GRINDING

PROCESS

WASTEWATER TREATMENT FACILITY

SOJP NO 1

Developed by Charles County Community College under
a grant with the

Manpower and Training Staff
Office of Water Programs Operations
Environmental Protection Agency

Standard Operating Job Procedures for the

Screening and Grinding

This Process was developed by:

Name Gerald A. Deal

Address Route 2
Boonsboro, Maryland 21713

Position Supervisor, Trainer O & M, Maryland Environmental Services

Education and Technical Background

Two years college

Fifteen years sewage treatment operation and related fields.

Name James A. Montgomery

Address Route 1, Box 112
Dolliver, Iowa 50531

Position Consultant, Trainer O & M

Education and Technical Background

B.A. General Science (Biology), 1955, University of Iowa

B.S. Civil Engineering, 1962, University of Iowa

M.S. Sanitary Engineering, 1964, University of Iowa

Twelve years sewage treatment plant operation and related fields.

Process Screening and Grinding

1. Operation Objectives

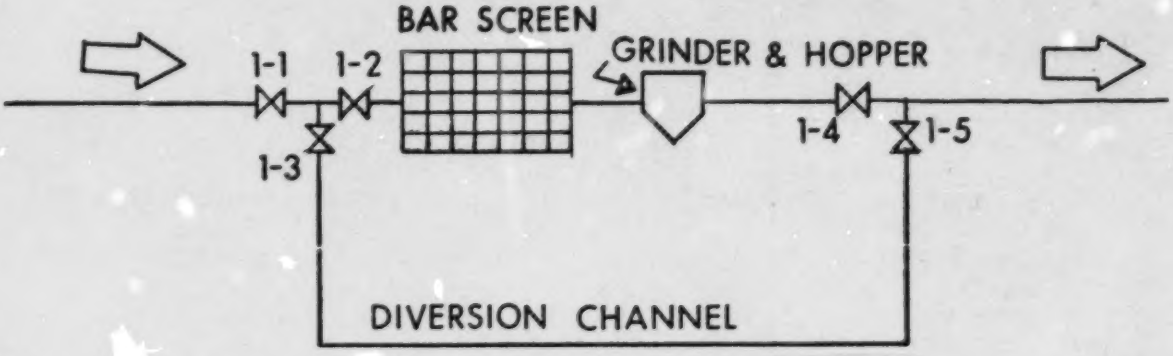
2. Brief Description of Process

1. The objective of this unit process is the removal of coarse materials from the raw waste stream for the protection of subsequent equipment and processes.

2. This unit process removes coarse debris from the waste stream by screening out all materials too large to pass through the bar openings. A cleaning mechanism transfers the material from the bars to the grinder where it is reduced in size, diluted with water, and returned to the waste stream flow.

Process Screening and Grinding

Flow Sheet



Process Screening and Grinding

General Description of Equipment Used in the Process

Metal bars are spaced 5/8" to 1" and placed in flow channel. Cleaning mechanism scrapes vertical bars from bottom to top and collects material and drops it into hopper. The hopper extends width of bar rack and serves to collect materials and transfer them to grinder. Horizontal grinder pulverizes materials by high speed rotating hammers. Flushing water and centrifugal thrust force pulverized material through perforated plate in lower part of grinder housing. Control mechanism senses differential height of wastewater upstream and downstream from bar rack and sends electrical current to switch on cleaning mechanism, solenoid valve of flushing water line, and grinder motor. Timers supplement control mechanism by intermittently cycling unit on a predetermined schedule and extending grinder and flushing water operation to assure complete emptying of grinder.

Equipment consists of:

1. Metal bars which are spaced 5/8" to 1" and placed in flow channel at an angle of 75° to 90° from horizontal.

2. A cleaning mechanism which scrapes bars from bottom to top.

3. A mechanism which dumps material from cleaning bars into hopper.

4. A hopper which extends full width of bars and collects material and transfers it to inlet of grinder.

5. A grinder which pulverizes collected materials.

6. A flushing water system consisting of sprayers, piping, solenoid valve and gate valve.

7. A control mechanism consisting of a differential bubbler system and timers.

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1 Prepared by G. A. Deal / J. Montgomery Date 12-14-72

PROCESS Screening & Grinding Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
A. PRE-START UP INSPECTION PROCEDURES			
HAZARD WARNING STATEMENT			I-1 & V-1
Complete facility including structure has been inspected and accepted from construction contractor and manufacturer/supplier by owner and is now shut down after having been operational for a period of time. Operator has studied and is familiar with prints and/or shop drawings of unit process and manufacturer's operation and maintenance manuals. (Several different brand names of equipment should be used in one unit process.)			
HAZARD WARNING			
Open Pit Moving Equipment Dangerous Gases			

8

9

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J. Montgomery Date 12-14-72

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
		The goal of safety is the continuous and efficient operation of unit without loss of health or comfort to the operator and loss of efficiency of unit.	
1. Safety Inspection	1. Inspect walkways.	1. Walkways and steps should be clean, free of obstructions, not slippery with oil, grease, ice, etc.	
	2. Inspect ladders and steps.	1. Ladders should have separate handrails and, if over 10 feet high, have safety cage.	
	3. Check safety signs.	1. Entrance to structure should have sign, warning: Open pit and moving equipment.	XII-6
	4. Check washdown hoses.	1. Washdown hoses should have racks and areas to drain.	XII-7
	5. Check hand tools storage area.	1. Hand tools should have storage area. 2. A list of tools on hand should be kept for replacement lists.	
	6. Check debris container.	1. Manually removed debris should have separate container with tightly fitting lid.	XII-9
	7. Check electric controls.	1. Electric controls should have locks with keys. 2. Electric controls should be clearly labeled.	XII-10

10

11

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

Prepared by G.A.Deal J. Montgomery Date 12-14-72

PROCESS Screening & Grinding

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	8. Check guards and protective shields.		
	9. Check safety switch on grinder door.		XII-11
	10. Check safety equipment.	1. Operator should have ready access to personal protective clothing and equipment. Boots, gloves, rain gear, safety helmet, gas masks and explosion-proof portable lights.	XII-12
2. Structure Inspection	1. All valves and flow control gates are closed to the process unit.		
	2. Flow diversion channel is in use.		
	3. Unit flow channels are empty and clean.		
	4. Electrical power is turned off, and all switches are locked and tagged.		IV-1

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal, J. Montgomery Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
3. Equipment Inspection	1. Check all tolerance, wear allowances, run-out, positioning and other conditions as set forth in manufacturers' operation and maintenance manuals.		IV-2, IV-3
	2. Check sluice gates.	1. Sluice gates should not leak under full flow. 2. Sluice gates should operate without excessive effort.	IV-3
	3. Check bars.	1. Bars should be evenly spaced, straight and smooth.	IV3, V-2
	4. Check collecting mechanism tines.	1. Tines must have proper shape and freedom of movement. 2. Check tines clearances.	IV-3, V-17 IV-3
	5. Check collecting mechanism shafts.	1. Shafts should be parallel to each other and perpendicular to chain & guide rails.	
	6. Check bearings.	1. Bearings should be tight & lubricated.	V-3, IX-1
	7. Check sprockets.	1. Sprockets should not be worn, loose or deformed.	
	8. Check hopper for smooth sides and slopes, proper location.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A. Deal
J. Montgomery

Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	9. Check grinder hammers.	1. Hammers should have free swing with proper clearance. Outlet plate should have proper shape and size hole.	V-4
	10. Check differential controller for proper volume and pressure primary and secondary air supply.	1. Bubble tubes not to be kinked, flattened or have horizontal swales.	V-5, V-10 V-9, V-8 VII-1
	11. Check timer stops and adjust.		V-6
	12. Check overload mechanism.		V-7, IX-2
	13. Check all gearboxes for proper amount and kind of lubricant.		V-3, V-16
4. Electrical Inspection	1. Check all control panels for heavy rubber mat on floor in operating area.	1. All inspection behind panels including proper sizing of fuses, heaters, etc., should be accomplished by maintenance crew unless operator is trained specifically to do this and is instructed and equipped to do it.	IX-3, XII-1

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A. Deal J. Montgomery Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	2. Check disconnect handles and function switches for lockouts with positive locks and tags.		XII-2
	3. Check all flexible connections for seals.	1. Connections should be tight, not worn frayed, or broken loose from sealing at connector.	XII-3, XII-4
	4. Motor rotation.	1. "Bump" the motor with the control switch Motor rotation should match rotation indicated on the housing.	V-15, IX-4
	5. Check light fixtures.	1. Light fixtures should be explosion-proof type with no cracked glass or broken shields.	XII-4
	6. Look for evidence of water leaks or condensation especially in control and switch gear areas (water marks or discoloration).		
	7. Look for evidence of high resistance connections, etc. (burned insulation, discoloration, charring, etc.).		XII-5

18

19

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J. Montgomery Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
B. START-UP PROCEDURES			
1. Fill Tank	1. Place chalk mark on vertical wall of channel at desired starting level.	1. Use folding rule to measure in flow channel.	I-2
	2. Close outlet gate.		
	3. Open inlet gate very slightly to allow sewage to fill flow channel to chalk mark.		
	4. Close inlet completely.		
2. Start Equipment Manually	1. Turn on air supply.	1. Check primary air pressure. Adjust regulator if necessary.	V-8
	2. Check air flow indicator.	1. Adjust if necessary to approximately middle of scale of indicator.	V-9
	3. Open air bleed valve in downstream bubble tube.	1. After pressure stabilizes for 15 seconds, differential depth indicator should show height equal to depth of sewage in flow channel.	V-10

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A. Deal
J. Montgomery

Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	4. Check depth indicator.	1. If indicator does not show depth of sewage, adjust to make it indicate correctly.	V-11 VIII-1 XI-1
	5. Observe pressure switch which is to start unit.	1. Electrical contacts should be "closed." This is in accessible panel.	VIII-2
	6. Open inlet gate slightly to produce flooded condition in flow channel. Close inlet completely.		
	7. Observe pressure switch which is to operate high level alarm.	1. Contacts should be "closed." This is in same panel with other pressure switches.	XI-2 I-3
	8. Turn power on to signal light or annunciator system.	1. Signal or annunciator should indicate high water alarm.	
	9. Operate manual system.		V-13
3. Start Automatic Control System	1. All controls remain in operation as in control check above.		

22

23

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J.Montgomery Date 12-14-72

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	2. Turn on process water manual valve.		
	3. Unlock and turn "on" electric switching gear.		IV-4
	4. Place function selector to "auto" position.		
	5. Check collector mechanism, flushing water and grinder.	1. All three units should be running.	V-14
	6. Allow unit to operate. Observe collecting mechanism, gear reduction unit, grinder unit, flushing action and volume.	1. Effectiveness of grinder cannot checked until an amount of debris is collected from bars during actual process operation.	
	7. Check mechanism for smooth movement without excessive noise, vibration or jerky movements.	1. Tines should be moving from bottom to top of bars.	I-4, V-5
	8. Unit will continue to operate as long as air bleed is open in downstream bubble tube.		I-5

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1 Prepared by G.A.Deal J.Montgomery Date 12-14-72

PROCESS Screening & Grinding Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	9. Check motors and drive units for (excessive) heat development, loss of oil or unusual noises.		II-1, V-19
	10. Check collecting tines.	1. Collecting tines should not rub on hopper, structure or other parts of equipment.	V-17
	11. Check operating of tine cleaning mechanism.	1. Many need adjustment of stroke or timing.	
4. Adjust Flow to Stable Condition	1. Turn off air bleed valve in downstream bubble tube.		
	2. With controls set as above and function switch in "auto" position. Air will stabilize in controller and collector mechanism. Grinder and flushing water will stop.		I-6, V-18 I-8

26

27

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J.Montgomery Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	3. Open outlet gate.	1. Should move without excessive effort.	
	4. Open inlet gate.	1. Should move without excessive effort.	
	5. Close inlet gate to flow diversion.		
	6. Close outlet gate to flow diversion channel after it drains.		
	7. As flow passes through bar screen, debris will collect on bars creating upstream head. Observe differential height indicator. When reading equals height originally set on controller will begin cycle to start grinder, flushing water and collector mechanism.		I-7
	8. Observe unit as it passes through entire cycle. Note any unusual noise vibration, motion or heat.		V-19

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1 Prepared by G.A.Deal J.Montgomery Date 12-14-72

PROCESS Screening & Grinding Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	9. As mechanism cleans screen allowing flow velocity to resume, upstream head will drop causing controller to stop equipment.		
	10. Check hopper.	1. Hopper should be emptied when grinder stops.	
	11. Check ground up debris.	1. Ground up debris should be fluid enough to drop freely into flow below.	VI-1

31

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

Prepared by G.A.Deal J.Montgomery Date 12-14-72

PROCESS Screening & Grinding

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
C. CONTINUOUS	OPERATING PROCEDURES		
1. Check Equipment	1. Unit in operation.		
	2. Observe height of fluid in channel.	1. Is it within normal operating range?	I-2
	3. Observe cleaning action of mechanism.	1. Does it clean bars and deposit debris completely into hopper?	
	4. Observe ground up debris.	1. Does it drop freely into channel and mix with flow?	
	5. Observe action of flushing water.	1. Does it continually clean hopper and move debris into grinder?	
	6. Check temperature of all motors.	1. Are they sensibly hot or warm?	I-9
	7. Check control panel lights and position of all controls.	1. Are they set for normal operation?	
	8. Check air flow volume indicator.	1. Is it set in normal range? Are moisture droplets visible?	
	9. Check air pressure on primary supply and secondary pressure from regulator to bubbletrol.	1. Does it hold steady and meet O & M specifications?	

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J.Montgomery Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	10. Check moisture trap in air supply line. Bleed moisture at cock.		VIII-3
	11. Check flow in unit. Observe characteristics and quantity of wastestream.		VI-2
2. Sample and Analysis		Process is not normally sampled or analyzed. Unit process structure may be site of raw sewage sampling station (see SOJP#4 - Sampling and Analysis). Unit process does not remove debris from flow stream, therefore, efficiency is not readily analyzed except by visual inspection of particle size.	
3. Process Adjustment	1. 2 hour tour abnormal conditions of flow. Head high in flow channel.	1. Flow is high in channel due to bars not being cleaned with unit not operating. Turn function switch to manual, unit should start immediately. Allow it to remain on manual until cleared. Return switch to "auto" and check action of controller as in prestart-up inspection by bleeding air from downstream bubble tube. Purge bubble tubes. Reset timer if necessary to anticipate high flow periods.	VIII-4

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

Prepared by G.A.Deal J.Montgomery Date 12-14-72

PROCESS Screening & Grinding

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	2. 2 hour tour abnormal conditions of flow. Head high in flow channel.	1. Unit not operating. Panel lights and/or position of controls indicate overload has tripped. Reset overload. Restart unit. Observe unit until cleared. Immediately request amperage and voltage tests by maintenance electrician unless there has been power outage or single phasing, etc., throughout the plant.	
	3. 2 hour tour abnormal conditions of flow. Head high in flow channel.	1. Motor and reduction unit operating, but mechanism not cleaning. Stop motor and replace shear pin. Operate on "manual" until bars are cleared. Return controls to "auto."	V-22
	4. 2 hour tour abnormal conditions. Low flow. Low head.	1. Unit continues to operate after normal cycle should be ended. Bubble tubes have resistance to air flow due to clogging or condensation. Stop unit. Purge tubes with air purging mechanism. Read differential height indicator. Normal reading indicates unit will not operate properly. Return controls to "auto."	

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J.Montgomery Date 12-14-72

Approved by

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
	5. 2 hour tour abnormal conditions. Debris accumulates in hopper.	1. Observe action of flushing water. Water flow is not sufficient to move debris down sides and into grinder. Temporarily add more water to hopper with hose until hopper is cleared. Adjust flushing water flow to move debris as it accumulates.	
	6. 2 hour tour abnormal conditions. Ground up debris drops from grinder in large clumps.	1. Debris is not sufficiently diluted with water. Increase quantity of water to hopper by adjusting flow control valve or pressure regulator until discharge from grinder is more fluid. Grinder timer may need to be set for longer cycle.	V-20 VIII-5
	7. Unit equipment is operating with low flow in channel.	1. This may be normal. Check timer. Is it facing "on" position? If so, unit will operate normally until timer moves to "off" position. Timer action is supplemental to controller, e.g., during low flow periods operating head may not develop for long time causing velocity to drop below one fps which will drop grit in flow channel. Timer can be set to operate intermittently during these low flow periods or to anticipate high flow periods.	I-4, I-10 V-6

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

PROCESS Screening & Grinding

Prepared by G.A.Deal J.Montgomery Date 12-14-72

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
D. SHUTDOWN PROCEDURES			
1. General	1. Unit is operating properly.		XII-8
2. Divert flow	1. Open diversion channel outlet gate.		
	2. Open diversion channel inlet gate.		
	3. Close unit process inlet gate.		
	3.a. Close unit process outlet gate.		
	4. Open drain line. Allow process unit to drain completely.		
3. Operator Collector Mechanism	1. Place function selector on manual, allow mechanism to operate until bars are completely cleaned and hopper is flushed and grinder clean and flushed.		

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1 Prepared by G.A.Deal J.Montgomery Date 12-14-72

PROCESS Screening & Grinding Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
4. Clear Grinder	1. Operate on manual until discharge from grinder is clear of solids.		
5. Controls "Off"	1. Turn off function selector, switch gear flushing water gate valve, air supply to bubbletrol.		V-21
	2. Lock out switch gear and tag.		IV-4
6. Flush Channel	1. Wash flow channel with spray from hose. Outlet gate must be open to do this. Also wash down walls, etc.		
7. Clean Equipment	1. Collectors, bars, hopper, grinder wash with hose spray. Tines, chains, railings clean stringy materials such as fibers, hair, wire by hand. Use rubber gloves (possibly may need pliers to pull tough fiber and hair which has become twisted).		XII-13

STANDARD OPERATING JOB PROCEDURES

SOJP NO 1

Prepared by G.A.Deal J.Montgomery Date 12-14-72

PROCESS Screening & Grinding

Approved by _____

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
8. Inspection	1. Check all components as in prestart-up.		
	2. Record all data from inspection.		XIII-1
9. Clean Manual Bar Screen on Diversion Channel			

TRAINING GUIDE

SECTION	TOPIC
I	Operating Theory
II	Educational Concepts - Mathematics
III	Educational Concepts - Science
IV	Educational Concepts - Communications
V	Process Equipment
VI	Process Flow - Characterization
VII	Process Control
VIII	Abnormal Operations - Trouble Shooting
IX	Maintenance Practices
X	Laboratory Practices
XI	Instrumentation - Automation
XII	Safety Practices
XIII	Records Reports

OPERATING THEORY

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
I-1 [A]	Operator should be familiar with plant and equipment O & M manuals before inspection. Force of flow places and holds debris against nearly vertical bars overcoming pull of gravity until cleaning tines remove it by upward motion. Attempt to maintain at least one fps during low flow periods and less than two fps during high flow periods. If cross sectional area of channel is too large to maintain one fps during low flow channel, area can be changed by added masonry fillers against vertical walls of channels.	Manufacturer's Operation, Maintenance Manual
I-2 [B.1.1.1] [C.1.2.1]	Control operates on back pressure principle as if water pressure were acting directly on diaphram. Bubbletrol furnishes constant small flow of air to bubble tube which is submerged on flow channel. As the depth of flow increases, air pressure increases in bubble tube which produces action of mercoids or diaphram switches.	Control Manufacturer's Manual
I-3 [B.2.7.1]	Electrical switching should be thought of as breaking or completing a circuit. Single phase current one wire only is switched. (Hot Wire).	
I-4 [B.3.7.1] [C.3.7.1]	Cleaning mechanism is "geared down" and moves slowly with a high torque available so if jerky motion is present, it is usually due to binding or high friction in some area of movement.	
I-5 [B.3.8]	No pressure in downstream tube makes differential pressure equal upstream depth. Upstream depth - 0 = differential depth.	
I-6 [B.4.1]	With flow level upstream and down, both tubes are equally submerged, therefore differential pressure is zero and controller turns "off."	

OPERATING THEORY

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
I-7 [B.4.7]	As debris collects on bars it lessens the cross sectional area of flow channel causing the same volume to pass through smaller area, therefore creating upstream head. Bubble senses head increase in form of increased back pressure causing operation of pressure switches.	
I-8 [B.4.2]	Flow head can increase above starting level because bars are not cleaned instantly and head can increase after start if flow contains sufficient amount of debris. If bubble is not sensitive enough to head changes, air flow increase in tubes will make it more sensitive but will also change indicator of differential height. Any significant changes made in air bubble flow should be accompanied by recalibration of indicator.	Control Manufacture's O & M Manual
I-9 [C.1.6.1]	Most electric motors made for continuous duty have ambient temperature rise of at least 40°C. This amount of increase will feel very hot to the touch. Learn to perceive this approximate temperature to the touch.	
I-10 [C.3.7.1]	It is undersirable to have flow move too fast or too slow through bars. Too slow causes deposits of grit and organic matter (less than one foot per second.) Too fast (more than 2 1/2 feet/sec) will carry coarse debris through bars without being collected and ground.	

EDUCATIONAL CONCEPTS -- MATHEMATICS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
II-1 [B.3.9]	Pressure switches may be calibrated in some unit other than feet of water head. Conversions can be made: 1 foot head water = $\frac{1}{2.31}$ psi = .433 psi 1 pound per square inch pressure = 2.31 feet head 1 inch mercury = 1.133 feet water = .491 psi 1 atmosphere = 14.7 psi = 29.9 in mercury Example 1 - How many pounds per square inch (psi) pressure are there under 60 feet head of water? pressure (psi) = $(60 \times \frac{1}{2.31})$ = 60 x 0.433 = 25.98 psi Example 2 - Ten (10) inches of mercury is equal to how many feet of water? feet of water = 10 x 1.133 = 11.33 feet	

EDUCATIONAL CONCEPTS -- MATHEMATICS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
II-1 [B.3.9]	Temperature $F = 32 + (9/5 \times C°)$ $°C = \frac{5}{9}(°F - 32)$ 40°C will feel warm to the hand and 50°C will feel hot. Example 1 - Convert 40°C to degrees Fahrenheit $40°C = 32 + (9/5 \times 40/1)$ $= 32 + \frac{360}{5}$ $= 32 + 72$ $= 104°F$ Example 2 - Convert 104°F to degrees Centigrade $104°F = \frac{5}{9}(104 - 32)$ $= \frac{5}{9} \times 72$ $= \frac{360}{9}$ $40°C$	

EDUCATIONAL CONCEPTS -- SCIENCE

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES

EDUCATIONAL CONCEPTS -- COMMUNICATIONS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
IV-1 [A.2.4]	Ability to read and write prerequisite to all communications.	
IV-2 [A.3.1]	If check lists not available operator can make one to be used with interplant memos One method could be for components to be listed vertically on lines and electrical, mechanical and safety listed in columns intersecting each line. Engineers folding rule is calibrated to read in feet, inches, tenths, and hundreths of feet. Many prints, drawings and manuals give elevations and dimensions in decimal form of feet.	
IV-3 [A.3.2.1] [A.3.3.1] [A.3.4.1] [A.3.4.2] [A.3.1]	Operator must be able to read and interpret specifications as given in charts, graphs, orthographic projections, schematic drawings. " " "	Manufacturer's O & M Manual
IV-4 [B.3.3] [D.5.2]	Indicate by tag nature and reason of lock-out. Be specific! Sign your name and date. Use accepted method and channels for communication to other crews. Written messages are usually clearer. Be specific! What, why, when. Sign name and date. Suggested Forms: Record Sheets Maintenance Forms Communication Forms	

PROCESS EQUIPMENT

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-1 [A]	Specifications for equipment often include the phrase "or equal" so many times a unit process will be made up of equipment from several manufacturers. Be familiar with all manuals corresponding to this process. Understand the function of each component and how it is needed in the whole and its relationship to other components.	Manufacturer's Manual
V-2 [A.3.3.1]	If all bars are parallel openings will be the same from end to end. These can be checked with measuring rule.	
V-3 [C.3.6.1] [A.3.1]	Some types of bearings need frequent lubrication and are lubed by operators. Some are sealed and need no lubrication. Understand the maintenance specifications and plant policy on lubrication. Water lubricated bearings should be lubed if run dry.	
V-4 [A.3.9.1]	All manufacturers' equipment does not have same type of hammers.	Grinder O & M Manual
V-5 [A.3.10.1] [B.3.7.1]	Air which is compressed and released into area of lesser pressure also changes temperature. Temperature change and pressure change cause condensation of moisture. When moisture droplets form in air equipment, the different resistance of water droplets to flow through small tubes and orifices will cause very erratic action of air control equipment, necessitating manual purging if automatic purging is not provided.	
V-6 [A.3.11] [C.3.7.1]	Adjustment of timer cycles should be by instruction of supervisor. Timer action supplements differential controller and extends grinder cycle.	
V-7 [A.3.12]	Actual testing of overload mechanism should not be attempted by operator.	

PROCESS EQUIPMENT

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-8 [B.2.1.1] [A.3.10.1]	See manual for actual desired operating range and how to adjust regulator.	Control O & M Manual
V-9 [B.2.2.1] [A.3.10.1]	Rate of flow of air directly affects entire operation of bubbletrol. Flow rate should be as specified.	Manual
V-10 [A.3.10.1] [B.2.3.1]	Resistance to air flow is transmitted to indicator via same tube that operates pressure switches in form of proportional increased air pressure.	
V-11 [B.2.4.1]	Indicator is not to be internally adjusted by operator. External adjustment is made by air changes.	Control O & M Manual
V-12 [B.2.5.1]	Pressure switches are labeled as to their function. "Closed" means the circuit is complete. Diaphram switches or mercoids usually operate linkage which tilts tube containing mercury metal and contacts connected to wires. When mercury is in contact with contacts it becomes part of circuit.	
V-13 [B.2.9]	Manual purge necessitates closing and opening proper valves to prevent damage to sensitive pressure switches.	
V-14 [B.3.5.1]	All motors will have separate electrical starters but will be operated from same control.	
V-15 [B.3.7.7] [A.4.4.1]	Mechanism can operate backwards due to direction of rotation of motor. Three-phase motors can operate either direction by changing two leads to motor.	

PROCESS EQUIPMENT

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-16 [A.3.13]	Do not attempt to check oil levels during operation. Learn to know normal amounts and kinds of noise of this unit. 40°C will feel very warm, 50°C very hot.	
V-17 [A.3.3.1] [B.3.10.1]	Tines will touch bars but should not rub with excessive pressure.	
V-18 [B.4.1]	Action of controller is not instantaneous Allow it to have time to react to pressure changes.	
V-19 [B.4.8] [B.3.9]	Manual will give clues to what is normal as far as noise, vibration, etc.	Equipment Manual
V-20 [C.3.6.1]	Function switch must be "off" during manual purge to prevent erratic action to switch gear.	
V-21 [D.5.1]	Disconnect switches should not be used to switch motors off or on due to arcing at point of contact. Use starter buttons to stop and start.	
V-22 [C.3.3.1]	Use proper size shear pin. Lubricate. Check for rust. If shear pin is rusted, it will cause a strong bond.	

PROCESS FLOW -- CHARACTERIZATION

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VI-1 [B.4.11.1]	Pulverized debris may tend to be pasty if not mixed with enough water. It should mix well with flow going to next process.	
VI-2 [C.1.11]	Flow to unit is raw sewage and is subject to great variations depending on source of wastewater. Also at low flow periods all debris is not suspended and carried with flow but will be scoured from flow channels during high flow periods.	

PROCESS CONTROL

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VII-1 [A.3.10.1]	Differential controller senses differential height of upstream and downstream head of flow and is supplemented by timer for high and low flow periods. Bubble tubes may be purged by primary air with automatic system consisting of 24-hour timer and solenoid valves in air flow tubes.	

ABNORMAL OPERATION -- TROUBLE SHOOTING

TRAINING GUIDE NOTE	TRAINING I[illegible] THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
VIII-1 [B.2.4,1]	Moisture and pressure changes cause control operational problems. If control has no air dryer in supply, frequent purging of bubble tubes may be in order (at least once/day).	
VIII-2 [B.2.5.1]	These pressure sensitive units cannot be subjected to any excessive internal or external forces so if they are damaged in any way do not attempt to repair. Have maintenance crew replace if damaged.	
VIII-3 [C.1.10]	If excessive moisture seems to collect, trap should be bled more often.	
VIII-4 [C.3.1.1]	Air flow to controls can be temporarily increased to make controls more reactive to differential head and afterward returned to normal flow if controls react favorably. Do not operate air flow to extremes. If this is necessary to cause control to operate, bubble tube is probably broken or leaking badly. Air flow may have to be adjusted permanently higher or lower than specified, if so, height indicator must be recalibrated and adjusted.	
VIII-5 [C.3.6.1]	If flow variations are extreme, timer operation will be more important and correlated settings more necessary.	

MAINTENANCE PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
IX-1 [A.3.6.1]	Be sure you understand plant policy and schedules on lubrication and plant maintenance and what your role is in this.	
IX-2 [A.3.12]	Do not attempt to counteract overload mechanism operation. Find cause of its operating and correct. Check with maintenance if overload causes chronic problems.	
IX-3 [A.4.1.1]	Do not experiment with any equipment or function beyond your knowledge or authority. Keep in mind high risk duties should be accomplished by experienced personnel.	
IX-4 [A.4.4.1]	Actual direction of rotation must be checked by "jogging" manual control while observing shaft of motor. Do not attempt to change wiring to correct an improperly wired unit.	

LABORATORY PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES

INSTRUMENTATION -- AUTOMATION

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XI-1 [B.2.4,1]	Function of control unit is to operate unit when necessary and as long as needed without excessive wear and power consumption. Controls must be properly adjusted and operated to give satisfactory operation of process unit. Learn principle of operation and operator's duties for continuous, efficient operation.	Control O & M Manual
XI-2 [B.2.7.1]	Air pressure produced as result of differential head on flow channel not only shows height on indicator but performs switching operation by moving pressure switch to "off" and "on" position.	

SAFETY PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XII-1 [A.4.1.1]	Do not attempt anything beyond scope of your knowledge or experience or responsibility. Mats are an added safety feature. If mat is dry, it will insulate you from accidental shocks.	
XII-2 [A.4.2]	Tags are to protect you and equipment.	
XII-3 [A.4.3.1]	Gas produced by anaerobic action is explosive. Sealed conduits prevent accidental explosions which can be caused by arcing of electricity.	
XII-4 [A.4.3.1] [A.4.5.1]	Any section of flexible wiring can quickly wear insulation and cause short circuiting and much more so if exposed.	
XII-5 [A.4.7]	A disconnected pipe may not be grounded sufficiently, therefore, would not be properly grounded when disconnected for some reason and could be the source of electric shock to operator.	
XII-6 [A.1.3.1]	You may know this, but does everyone who may visit or come near?	
XII-7 [A.1.4.1]	Disease can be transmitted by direct contact with broken skin or breathing droplet borne viruses and other microorganisms. You are working with waste stream flow which is not disinfected or lessened in any way of its disease producing ability.	
XII-8 [D.1.1]	Many accidents are caused by tools dropping or falling into equipment in use. Operator impulse may be to retreive it to his own detriment. Be familiar with emergency shutdown.	

SAFETY PRACTICES

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XII-9 [A.1.6.1]	Uncovered debris will cause odors, be a breeding place for flies and other insects, and attract rodents.	
XII-10 [A.1.7.1]	If you have the key, unit cannot be accidently started while you are in pit or working on unit.	
XII-11 [A.1.9]	This will not only prevent starting while door is open for servicing, but will stop unit if door comes loose during operation. Remember tip speed of grinding hammers is very fast.	
XII-12 [A.1.10.1]	Personal protective equipment may be clumsy or seem to cause inefficiency in your movements but by using it regularly, you will become accustomed to it. Remember your loss of health or body members may cause permanent inefficiency. In some instances, efficiency must be compromised for safety's sake.	
XII-13 [D.7.1]	If possible, do not expose body directly to sewage or sewage debris because of possibility of infection and disease. Always wash thoroughly before eating, smoking, etc.	

RECORDS -- REPORTS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/ TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
XIII-1 [D.8.2]	All operations of significance should be recorded for reference. Items of importance to plant operation, efficiency, preventive maintenance, safety, analyses and tests from flow are valuable for prognosis concerning future of process and related processes and impact on other processes. Unit operation should have: 1. Check list for daily operation recorded on some log form. 2. PM form 3. Nomenclature form 4. Repair listing form 5. Lubrication schedule 6. Operation record 7. Inspection check list	